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THE AGE OF THE TYPE EXPOSURES OF THE LAFAYETTE FORMATION¹

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The following brief communication is devoted to showing the Eocene age of the type-sections of the Lafayette formation in Lafayette County, Mississippi, and also at certain additional localities in northern Mississippi and southwestern Tennessee where fossil plants have been collected by the writer.

The term Lafayette formation has come in late years to be widely used by American geologists and the volume of literature devoted to its consideration is by no means inconsiderable.

It is not necessary in the present connection to recite the history of the study of the deposits which have been referred to the Lafayette. It will suffice to recall that the name was proposed by Hilgard² in 1891 for those deposits so elaborately described in his *Geology of Mississippi*³ as the Orange Sands, and typically developed in Lafayette County. Chief among the students of the Lafayette was W J McGee who extended their occurrence from Mississippi to Pennsylvania on the one hand and as far as Texas on the other.⁴

The writer is not concerned in the present brief note with those deposits in the various Atlantic and Gulf states which have been referred to the Lafayette formation by different geologists. In certain limited areas, however, reliable data have been obtained which may appropriately be announced in the present connection. Thus in the vicinity of Columbus, Georgia, materials classed as Lafayette are Cretaceous in age. Other materials referred to

¹ Published by permission of the Director of the U.S. Geological Survey.

² Hilgard, *Amer. Geol.*, VIII (1891), 130.

³ Hilgard, *Rept. on Geol. and Agr. of Miss.* (1860), 5-46 (the name Orange Sand was that of Safford, 1856).

⁴ McGee, *U.S. Geol. Surv., 12th Ann. Rept.*, Part I (1891), 347-521.

the Lafayette in the vicinity of Glen Allen, Fayette County, Alabama, should be assigned to the Tuscaloosa. In several sections across the Cretaceous of northeastern Mississippi in the latitude of Tupelo and Booneville, the Lafayette cover in all observed exposures resolves itself into the weathered beds of the Cretaceous. The same statement is true in the writer's judgment of the great cut near Cypress, Tennessee, on the Southern Railway. This whole section was included in the Orange Sand by Hilgard and figured diagrammatically on p. 16 of his *Geology of Mississippi*, though it was subsequently shown that the basal part was Ripley Cretaceous. The writer visited this exposure during the past season and failed to see any reason for not including it all in the Ripley. Furthermore, at a large number of localities throughout the Mississippi embayment area, Pleistocene terrace deposits have been referred to the Lafayette formation.

During 1910 it was the writer's privilege to spend considerable time in the collection of fossil plants in Lafayette County, Mississippi, and northward as far as Cairo, Illinois. It might be added parenthetically that five previous field seasons spent, for the most part, along the inner margin of the coastal plain from New Jersey to Mississippi have afforded considerable opportunity for observing the so-called Lafayette.

It has been commonly supposed for some years back that the Lafayette formation of Mississippi and western Tennessee was not a unit, since remains of the so-called eolignitic flora have been reported from time to time as occurring in it at numerous localities. It has been assumed, however, that these plants came from the Eocene clays beneath overlying Lafayette materials. While at most of the localities visited during 1910 the Wilcox clays with leaf impressions are overlain by reddish sands of no considerable or uniform thickness, this is not always the case, as is well shown by one of the exposures along the Illinois Central Railroad just north of Oxford, Miss. The outcrops in these railroad cuts, a number of views of which, from photographs by the writer, are here reproduced, were the type-sections of Hilgard's Orange Sands and Lafayette. Here as at every other locality where the writer collected plant fossils in Lafayette and Marshall counties, Missis-

issippi, and in Fayette and Hardeman counties, Tennessee, there is no unconformity between the Eocene Wilcox leaf beds and the supposed Lafayette if the latter be restricted to the few upper feet of weathered sands.

In order that there might be no room for doubt but that the Oxford exposures furnish the type-sections for the Lafayette, Dr. McGee has kindly prepared the following letter covering this point, at the request of Dr. T. Wayland Vaughan, geologist in charge of the coastal plain investigation for the U.S. Geological Survey:

[Copy]

March 1, 1911.

MY DEAR DOCTOR VAUGHAN: In further reply to your oral inquiry: On looking up the records, I find it clear that the type locality in Lafayette County, Mississippi, from which the Lafayette formation received its current designation, is Oxford, the site of the state institution of learning with which Dr. Hilgard was long and honorably connected; and that the type-section is the exposure in the Illinois Central Railway cut at Oxford shown by Dr. Hilgard in *Geology and Agriculture of Mississippi* (1860), p. 6, in the drawing reproduced by me in "The Lafayette Formation" (*Twelfth Annual Report, U.S. Geological Survey*, Fig. 58, p. 457). This section was in good condition for examination in 1891, and was re-examined as the type-section by Dr. Hilgard, the late Dr. J. M. Safford, Dr. Eugene A. Smith, Dr. Joseph A. Holmes, Professor Lester F. Ward, Mr. Robert T. Hill, and myself, jointly, and was still in good condition in February, 1910, when re-examined by Dr. E. N. Lowe, state geologist, and myself, as the type-section of the formation.

Yours sincerely,

(Signed) W J MCGEE

In the exposures at Oxford the deposits are a unit with every gradation from unweathered materials below to oxidized and more or less ferruginous sands above. Nowhere in this region is there a line of unconformity or a pebble bed to mark the supposed time interval extending from the early Eocene to the Pliocene. The change in color of the materials when marked at all is at varying levels and is due apparently to the depth to which the ferric oxide in the sands has been dehydrated. A quotation from McGee's longer paper on the Lafayette will make it clear that he did not recognize any unconformity between the leaf-bearing clays now ascertained to be Eocene, and the overlying sands. On pp. 458, 459, he says:

Several competent geologists familiar with the Lignitic in Mississippi, Alabama, Tennessee, and Arkansas are disposed to refer the leaf bearing clays to that formation on the ground of lithologic resemblance. If this reference be just, then the thickness of the formation may be less than that assigned by Hilgard at Oxford and Johnson at Holly Springs, and even the exposed thickness at La Grange may include an unknown amount of the protean Lignitic deposits though no demarcation has ever been found.

At one of the Oxford exposures, previously mentioned, the Eocene clay lens is almost at the surface and overlies "typical

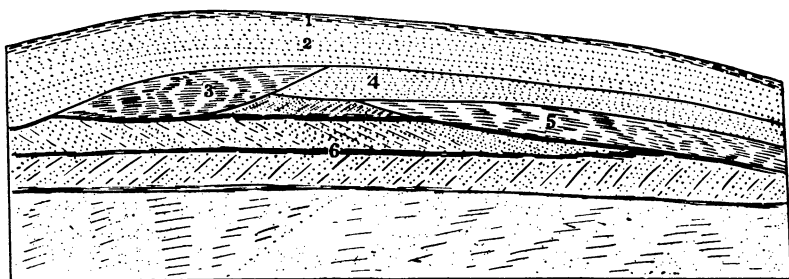


FIG. 1.—Diagram of exposure furnishing fossil leaves in the type area

Lafayette materials." This section is shown diagrammatically in Fig. 1, and may be described as follows:

SECTION EAST OF I.C.R.R. $\frac{1}{2}$ MILE NORTH OF OXFORD STATION

No.	1. Brown loam	1- 2 ft.
	2. Rather coarse brown stratified sand	4- 6 "
	3. Lens of gray to white siliceous clay, carrying abundant leaf impressions	0- 5 "
	4. Stratified orange sand	2- 3 "
	5. Lens of gray siliceous clay, with poorly preserved leaf impressions	0- 4 "
	6. Coarse brown cross-bedded sands separated by ferruginous indurated bands 1 to 3 inches in thickness. Replaced horizontally by pinkish or grayish buff finer sands	10-12 "

Fig. 2 is from a photograph of this outcrop, the fossil plants having come from near the top of the exposure at the "nose" just below the small tree shown in the center of the picture. The clays at this point are siliceous and do not contain an extensive flora, and the collections consist largely of the abundant remains



FIG. 2.—View showing the plant locality one-half mile north of the depot, Oxford, Miss.



FIG. 3.—View showing ferruginous cross-bedded sands just north of the plant locality.

of a *Panax*-like form and a fan palm identical with what Lesquereux called *Sabal grayana*. The latter was originally described from the Lignitic¹ and the former, while apparently new, is closely allied to early Tertiary forms from southern Europe. Few forms abundantly represented may be taken as indicating that the plants were not drifted into the basin of sedimentation from a



FIG. 4.—View showing the type-section of the Lafayette just south of the depot at Oxford, Miss.

distance but that they grew in the immediate vicinity and that the shallow waters of the Mississippi gulf in Wilcox time were not marine in this latitude. This is also indicated by the impressions of *Unios* in this same clay lens. At some of the other plant localities visited, as for example that at Holly Springs and Early Grove in Mississippi and at Grand Junction and La Grange in Tennessee, all of which are specific Lafayette localities of McGee, the fossil floras are more varied and consist of species of *Cercis*, *Laurus*,

¹ Lesquereux, *Proc. Amer. Philos. Soc.*, XIII (1869), 412, Pl. XIV, Figs. 4-6.

Ceanothus, Banksia, Dryophyllum, Sabal, Ficus, Dalbergia, Nerium, Terminalia, and perhaps one hundred additional forms, including even flowers and Acacia-like pods, all unquestionably of Eocene age and closely paralleling the Eocene floras of southern Europe. Furthermore these Eocene forms are all of them contained in beds absolutely inseparable from the surficial more or less



FIG. 5.—View showing the character of the materials referred to the Lafayette, one mile north of depot, Oxford, Miss.

oxidized sand which a forlorn hope might lead one to retain as representing the Lafayette.

It must not be supposed that there are no surficial deposits in this general region. The present communication is merely intended to show that certain fossiliferous sections including the type-section of the Lafayette and probably all of the Lafayette in Lafayette County, Mississippi, are of Wilcox Eocene age. A possible objection to the foregoing conclusion might be that these floras upon which it is in part based are really Lafayette floras. This is

utterly impossible. In the first place it would mean that the balance of the leaf-bearing Wilcox is of Lafayette age since the two have a considerable number of species in common. McGee seems to have had some premonition that the fossil plants when studied would not bear out his conclusions since he writes:

The testimony of the plant fossils is of course only suggestive; for not only is the identification incomplete, but there are thus far no means of comparing the stages in evolution of plant life in the upper Missouri and Rocky Mountain regions and the lower Mississippi region respectively; it can only be said that in the one region the geography was repeatedly revolutionized in such way as greatly to modify climatal conditions, while in the other the geography has undergone only minor changes of such character as not to modify climate, so that the flora has undoubtedly persisted in the remarkable fashion suggested by the present existence of Laramie or Lafayette plants in Louisiana.

This may be dismissed as a specious argument, for it can readily be shown that no post-Miocene floras of the northern hemisphere contain the types which are prominent in this flora. On the other hand the climatic changes have been considerable, even the Pliocene flora in this area of supposed slight change containing species no longer present in the region or even in North America.

In the second place the flora is closely allied to European floras of unquestioned Eocene age, more especially to that described by Saporta from France, and in its *tout ensemble* it denotes climatic conditions very different from those which could possibly have existed in Lafayette time.

There are high-level gravels in northeastern Mississippi and in northern Tennessee and beneath the loess along the Mississippi bottom ("delta") as well as at various points along the Atlantic Piedmont border. Whether these are river gravels of various ages or whether we are dealing with the remnants of a high-level early Pleistocene sea terrace is not clear, although a combination of the two is the probable solution.